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FEDERAL COMMUNICATIONS COMMISSION
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VIA COURIER

Ms. Magalie Roman Salas, Secretary
Federal Communications Commission
445 12th Street, S.W., Room TWB204
Washington, D.C. 20554

Re: Intersil Corporation
***Ex Parte* Filing**
Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices
ET Docket No. 99-231

Dear Ms. Salas:

Intersil Corporation ("Intersil") submits this written *ex parte* communication pursuant to Section 1.1206(b)(1) of the Commission's Rules. The original and one copy are enclosed for filing in the above-referenced proceeding.

Intersil's *ex parte* submission respectfully requests that the Commission reject the proposal to amend its frequency hopping regulations to permit wide band frequency hopping ("WBFH") systems. As the record in this proceeding amply demonstrates, there are serious concerns, supported by sound engineering analysis, that WBFH would cause harmful interference to existing and future frequency hopping and direct sequence spread spectrum equipment. Intersil also respectfully requests that the Commission maintain its CW jamming margin test, together with a mathematical calculation demonstrating compliance with the FCC processing gain standard, as proposed in the Notice of Proposed Rulemaking.

Please date-stamp the extra copy of this letter and return it in the enclosed envelope. If you have any questions regarding this filing, please contact Jim Zyren at (407) 729-4177.

Very truly yours,

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EX PARTE SUBMISSION OF INTERSIL CORPORATION

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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Jim Zyren
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SUMMARY

Over the years, the Commission has developed rules governing frequency-hopping equipment. Such rules, based on a sound engineering foundation, were designed to provide maximum flexibility in operations while simultaneously permitting the sharing of spectrum with other authorized operators and devices. In this proceeding, the Commission has requested comment on whether to dramatically revise its frequency hopping rules to permit wideband frequency hopping ("WBFH") systems. However, to accommodate WBFH, the Commission would be required to overturn long-standing policies intended to secure harmonious sharing of unlicensed spectrum.

In order to undertake such drastic changes to its rules, the Commission must ensure that it accounts for existing precedent and utilizes the same sound engineering analysis in establishing new policies. The record in this proceeding, including CUBE's reply comments and *ex parte* submission, not only lacks the foundation for such changes in the Commission's rules, but also underscores the reasons for the Commission's existing policies. Thus, the Commission should decline to adopt the WBFH proposal and should retain its existing rules for frequency hopping systems.

The Commission should also retain its existing CW jamming margin test, used to ensure direct sequence spread spectrum ("DSSS") system compliance with the FCC's processing gain requirements. Together with a mathematical calculation intended to demonstrate compliance for equipment using spreading codes of under 10 chips per symbol, the CW jamming margin test is still the best means for measuring conformance with the Commission's processing gain standard. If the Commission requires the BLN test, it should also require mathematical support confirming compliance with the processing gain requirement.

Ex Parte Submission of Intersil Corporation
ET Docket No. 99-231

I. The Wide Band Frequency Hopping Proposal Conflicts with the Commission's Long-Standing Spread Spectrum Policies Designed to Avoid Harmful Interference

After a round of reply comments and the filing of several *ex parte* submissions regarding the Commission's Notice of Proposed Rulemaking in this proceeding ("NPRM"), several technical aspects of HomeRF Working Group's ("HomeRF's") wideband frequency hopping ("WBFH") proposal are in dispute. Among the issues in controversy are the use of overlapped channels, the adequacy of proposed reductions in transmitted power limits, and the predicted performance of WBFH receivers. Each of these issues relates directly to the level of interference that other services operating in the 2.4 GHz band will encounter as a result of the authorization of WBFH devices.

The use of overlapping FHSS channels will result in collisions among WBFH systems that will be both more frequent and more severe than comparable systems that employ non-overlapping channels. The underlying characteristics of FM detection that lead to this effect have been described in a previous submission to the Commission in this proceeding.[1]

In order to compensate for the expansion in channel width, the proponents of WBFH have suggested transmitted power limit reductions that are intended to reduce the risk of interference to other users of the spectrum. However, the proposed power reductions are entirely inadequate to protect other users of the 2.4 GHz band, including existing frequency hopping ("FH") radios. In many cases, the "reduced" power limits are in excess of the transmission

[1] Zyren and Gandolfo, "*Analysis and Simulation of Overlapped Frequency Hopping Channels,*" Comments of Intersil Corporation (filed September 7, 1999 in this proceeding) (hereinafter *Intersil Analysis of Overlapped FH Channels*).

power levels of the vast majority of devices already in service. For example, the proposed power limit for WBFH devices having a 5 MHz channel width is 200 mW. By comparison, all DSSS radios manufactured and marketed for indoor use operate at or below 100 mW, and the majority operate below 50 mW. In addition, Bluetooth devices will be produced in very large volumes, and most of these radios will have a transmitted power of just 1 mW.

The issue of WBFH performance is also relevant to a discussion of interference to other services in the 2.4 GHz band. As described by proponents, WBFH radios are intended primarily for consumer applications, including multimedia applications such as streaming video and CD quality audio.[2] Radios that are inherently unreliable or that are highly susceptible to interference require an excessive rate of retransmission to deliver required throughput. Because WBFH radios would be highly susceptible to interference, their use for high rate, multimedia applications will result in WBFH radio transmissions at high power on essentially a continuous basis in order to service the intended applications. Thus, WBFH radios, by their nature, would be highly likely to cause harmful interference to existing FH and direct sequence spread spectrum ("DSSS") systems.

In previous proceedings, the Commission has established policies or rules directly addressing each of these issues. As described below, the Commission has previously rejected the use of overlapped channels for FHSS radio applications. The Commission has also found that power reductions for FHSS radios which are linear in proportion to the proposed expansion in channel width are inadequate to protect other users of the spectrum. Further, the Commission has explicitly stated that receiver performance is a critical aspect of FHSS system operations.

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[2] HomeRF Working Group, Letter to the Office of Engineering and Technology, November 11, 1998 (made part of this docket September 8, 1999).

Because the industry relies on the consistency of the Commission's rules and policies to manufacture and market equipment, departures from previous Commission rulings and long-standing precedent should only be considered when the technical material in the record clearly indicates that the Commission's previous position was flawed, or that the benefits of such departures clearly outweigh the drawbacks. "It is axiomatic that an agency choosing to alter its regulatory course must supply a reasoned analysis indicating that its prior policies and standards are being deliberately changed, not casually ignored."[3] The record in this proceeding clearly shows that the Commission's long-standing position on each of these issues is based on sound engineering, and therefore the Commission should continue to uphold its existing policies and reject the WBFH proposal.

A. To Prevent Harmful Interference, FCC Rules and Policies Prohibit Overlapping FH Channels

The use of overlapping channels for FHSS systems remains a point of debate between WBFH supporters and WBFH opponents. However, the Commission has specifically recognized the importance of non-overlapping FH channels in preventing harmful interference to other spread spectrum devices. The use of overlapping channels is currently prohibited the Commission's Rules, which state:

> *Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.*[4]

[3] Action for Children's Television v. FCC, 821 F.2d 741, 745 (D.C. Cir. 1987) (internal quotations omitted).

[4] 47 C.F.R. § 15.247(a)(1).

In a 1989 Notice of Proposed Rulemaking,[5] the Commission proposed to widen the channel width for FHSS systems from 25 kHz to 500 kHz for both the 900 MHz and 2.4 GHz bands. In regard to the proposed expansion of channel width in the 900 MHz band, the Commission wrote:

> *Increasing the channel bandwidth to 500 kHz will require a concomitant change in the minimum number of hopping frequencies from 75 to 50 for systems operating in the 902 to 928 MHz band.*[6]

In the subsequent Report and Order, the Commission addressed the same topic:

> *To accommodate the increased channel bandwidth in the 902-928 MHz band and still retain the non-overlapping hopping channel requirement, the required number of hopping frequencies for systems using this band was proposed to be reduced from 75 to 50.*[7]

Thus, in adopting a reduction in the number of FH channels in the 900 MHz band, the Commission specifically precluded the use of overlapping channels for FHSS systems, recognizing the importance of this policy in preventing harmful interference to other systems sharing the band.

Intersil's analysis filed with the Commission in this proceeding[8] shows that the use of overlapping FHSS channels actually increases the level of interference among WBFH systems due to the properties of FM demodulators. Intersil's findings have been independently

[5] Amendment of Parts 2 and 15 of the Rules with Regard to the Operations of Spread Spectrum Systems, *Notice of Proposed Rulemaking*, 4 FCC Rcd 6370 (1989).

[6] *Id.* at 6374, n.9.

[7] Amendment of Parts 2 and 15 of the Rules with Regard to the Operations of Spread Spectrum Systems, *Report and Order*, 5 FCC Rcd 4123 (1990) at ¶ 18.

[8] *See Intersil Analysis of Overlapped FH Channels, supra* note 1.

confirmed by Silicon Wave.[9] At the same time, the proponents of WBFH have failed to submit any technical support to backup their arguments.

The current WBFH proposal to use overlapping FHSS channels is a departure from long-standing Commission precedent. A policy against overlapping FH channels is intended to prevent harmful interference to other spread spectrum equipment. A departure from this policy should be contemplated only if the departure is backed by sound engineering analysis. Based on the record in this proceeding, sound engineering analysis indicates that the Commission's long-standing requirement for use of non-overlapping channels for FHSS systems is thoroughly justified.

B. The Power Reductions in the WBFH Proposal Are Inadequate to Prevent Undue Interference to Other Users

In an attempt to ward off claims of harmful interference from WBFH, HomeRF proposed WBFH power reductions that are linear in proportion to the expansion of the occupied channel width. These power reductions are identical to those proposed by Symbol in a previous petition for rule making and rejected by the Commission out of concern for "severe potential for harmful interference":

> *We have serious concerns that implementing Symbol's requested changes [to the FH Rules] could result in severe increases in the potential for harmful interference, both to authorized radio services and to other Part 15 devices . . . . Symbol's request to decrease the number of hopping channels would result in an increase in the average time during which the channels are occupied by a spread spectrum system. In addition, Symbol's request to increase the bandwidth of the hopping channels would broaden the spectrum over which interference from the frequency hopping systems could be received. Thus, we believe that implementing these changes would be detrimental to other narrowband and wideband systems*

[9] *See Ex Parte* Submission of Silicon Wave (filed December 28, 1999, in this proceeding).

operating in these bands. While this increased interference potential could be partially offset by a reduction in the output power of the frequency hopping transmitters, we are not convinced that a linear power reduction alone is sufficient to offset this interference potential.[10]

Unlike Symbol's proposal, the current WBFH proposal put forward by HomeRF does not contain a reduction in the number of hopping channels. This has necessitated the use of overlapping FHSS channels. As described above, the Commission has consistently and explicitly required the use of non-overlapping channels in the manufacture of FHSS radios. Further, the Commission has established a precedent for the degree of power reduction required for FHSS systems when the number of non-overlapping channels is reduced. In a 1996-1997 proceeding, the Commission considered reducing the number of hopping channels for FHSS systems operating in the 900 MHz band. In the Notice of Proposed Rulemaking, the Commission specifically sought comment on whether power reductions that were linear in proportion to the reduction in the number of channels were adequate to offset the potential increase in interference to other services.[11]

In the subsequent Report and Order in the 1996-1997 proceeding, the Commission indicated that power reductions should be in proportion to the square of the reduction in the number of non-overlapping channels. FHSS systems operating in the 900 MHz band which employ half the number of hop frequencies (25 vs. 50) must reduce transmit power by a factor of four (250 mW vs. 1 W):

The formula developed by TIA Wireless indicates that a frequency hopping system using 25 hopping channels should have a transmitter output limit of 250 mW in

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[10] Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters, *Notice of Proposed Rulemaking*, 11 FCC Rcd 3068 (1996) at ¶ 23.

order for the interference potential to be no greater than that of a 50 channel system operating with a transmitter power of 1 W.[12]

In the same Report and Order, the Commission concluded that it concurred with the analysis of TIA Wireless. This analysis formed the basis of the Commission's final ruling in this matter:

> *The Commission also agrees with the technical analysis presented by TIA Wireless that the peak output power of a spread spectrum transmitter operating with less than 50 hopping channels should be reduced to 250 mW with a maximum directional antenna gain of 6 dBi. As shown by TIA Wireless, this change is necessary to avoid increasing the interference potential of frequency hopping spread spectrum systems operating with a reduced number of hopping channels. Accordingly, the regulations are being amended to adopt a peak transmitter limit of 250 mW for frequency hopping spread spectrum systems operating with less than 50 hopping channels.*[13]

The proposed linear power reductions for WBFH systems operating in the 2.4 GHz band simply have not been justified by proponents. Power reductions that are linear in proportion to an expansion in channel width have been considered by the Commission previously and have been rejected. The engineering analysis in this proceeding supports Commission precedent in requiring that FH power reductions be in proportion to the square of the reduction in the number of non-overlapping channels in order to prevent harmful interference to equipment sharing the 2.4 GHz band. The Commission should therefore uphold existing precedent and reject the WBFH proposal.

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[11] *Id.* at ¶ 34.
[12] Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters, *Report and Order*, 12 FCC Rcd 7488 (1997) at ¶ 26.
[13] *Id.* at 29.

C. WBFH System Performance Will Cause Harmful Interference to Existing Systems

A primary argument in support of WBFH is the purported system performance benefit that will accrue to consumers. As Intersil has demonstrated throughout this proceeding, WBFH systems will not be capable of delivering the benefits to consumers as claimed by HomeRF and CUBE. However, WBFH equipment's inability to perform represents more than a broken promise; it also represents a serious likelihood of causing harmful interference to existing and future spread spectrum systems, particularly within the small office and home environments.

Systems which cannot reliably deliver claimed data rates and which are highly susceptible to interference require high rates of retransmission due to dropped data packets. A high rate of packet retransmission will necessarily extend the "on air" time for WBFH radios, which in turn will result in increased levels of interference to other users in the band. This is particularly true for systems serving multimedia applications, which will require reliable delivery of highly speed digital data on essentially a continuous basis. These are precisely the applications cited by WBFH proponents in touting the benefits of their proposal.

The possibility of multiple radio types operating within the small office and home environments is extremely likely within the next two years. Bluetooth radios will be installed on virtually every new cell phone and laptop computer. The Wireless Ethernet Compatibility Alliance ("WECA") has identified the home space as a key market segment for IEEE 802.11 DSSS radios. Based on the user applications cited by WBFH proponents, WBFH radios will therefore be operating in close proximity to other spread spectrum radio types.

Technical material submitted by CUBE substantiates Intersil's position that WBFH radios will be highly susceptible to interference.[14] In particular, CUBE's own data indicates that OpenAir radios are susceptible to interference over a bandwidth that is three times the nominal transmit channel width.[15] As undesirable as this situation is for radios having a 1 MHz transmit channel width, it is *far worse* for radios having 3 or 5 MHz channel widths. Scaling these results leads to the conclusion that WBFH radios will have bandwidths of susceptibility to jamming of over 15 MHz.

Not only would such a high degree of susceptibility to interference result in a radio with low reliability and a high packet retransmission rate, it is inconsistent with the Commission's Rules. Receiver characteristics are inextricably linked to the overall performance of spread spectrum systems. This fact was explicitly recognized by the Commission in an earlier proceeding in which it sought to "provide clarification of the minimum operating characteristics for direct sequence and frequency hopping systems to qualify for operation under Part 15 rules and expand and refine the permissible operating characteristics for frequency hopping systems."[16] In particular, the Commission concluded:

> *We agree that it is necessary to treat frequency hopping transmitters and receivers as a system in order to ensure that the spectrum efficiencies made possible through true spread spectrum operations are in fact achieved. We therefore are specifying certain basic standards for frequency hopping receivers. Receivers intended for use with frequency hopping systems will be required to have an input bandwidth that matches the hopping channel bandwidth of the*

[14] Reply Comments of the Wireless Ethernet Compatibility Alliance (WECA) -- Technical Statement, filed January 19, 2000, in this proceeding.

[15] *See* Reply Comments of Committee for Unlicensed Broadband Enablement ("CUBE") (filed November 19, 1999 in this proceeding), Table 1 at 35 and Table A3-1 at A3-6.

[16] *Report and Order*, 5 FCC Rcd 4123 at ¶ 1.

associated transmitter and will be required to hop in synchronization with the transmitter.[17]

The Commission's intent is clearly reflected in the current language of Section 15.247 (a)(1), which states:

The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters . . . .[18]

The issue of receiver performance is not peripheral to the discussion of WBFH systems. Rather, it is central to the question of whether such systems can operate in an unlicensed environment without contributing unnecessarily to the level of interference encountered by other users of the spectrum. HomeRF's claimed cost advantages for WBFH are in fact based on *design compromises* which, among other things, *directly affect the receiver's ability to reject out-of-band interference.* These compromises are inconsistent with the Commission's Rules, and will lead to excessive interference from WHFH systems due to their inherent unreliability and high rate of retransmission in the presence of even low levels of interference.

Although WBFH is being presented to the Commission as a consumer-oriented wireless networking technology, operation would be permissible in any environment. The Commission must carefully weigh the impact of WBFH on other radio technologies already authorized for use in the 2.4 GHz ISM band. Due to the use of overlapping channels and a higher minimum mandatory hop rate, the current proposal is technically inferior to an earlier proposal involving the expansion of FHSS channel bandwidths in the 2.4 GHz band, which the Commission rejected. In rejecting the earlier proposal, the Commission stated:

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[17] *Id.* at ¶ 26.

[18] 47 C.F.R. § 15.247(a)(1).

[I]n this case we feel that the large increase in the proliferation of these transmitters from additional consumer applications, combined with the smaller number of hopping channels, an increased bandwidth, an increased channel occupancy time, and, in some cases, a higher effective radiated power, would result in a significant increase in the probability that harmful interference will occur to other radio operations in these bands.[19]

HomeRF has not presented any technical basis for a different result in this proceeding.

The issues of overlapping channels, transmit power reductions, and relevance of the FHSS receiver reliability have all been addressed by the Commission in previous proceedings. In each instance, the Commission's previous findings are in conflict with the current WBFH proposal. Departures from previous findings and existing precedent should only be contemplated when there is clear technical supporting evidence that such changes are warranted. This is not the case in the current proceeding. The Commission's prior findings are well supported by the record in this proceeding, and are in conflict with the proposed operating characteristics of WBFH radios. Therefore, the current WBFH proposal should be rejected by the Commission.

II. The Commission Should Retain the CW Jamming Margin Test to Determine Compliance with Direct Sequence Processing Gain Requirements

In the NPRM, the Commission also proposed amending its DSSS Rules. Specifically, the Commission proposed requiring manufacturers of DSSS equipment with spreading codes of less than 10 chips per symbol to submit an additional mathematical justification verifying compliance with the DSSS processing gain. Such a mathematical justification would be mandated in

[19] *Notice of Proposed Rulemaking*, 11 FCC Rcd 3068 at ¶ 23.

addition to compliance with the existing CW jamming margin test.[20] Intersil supports this Commission proposal to require an additional mathematical justification requirement for systems utilizing spreading codes with less than 10 chips per symbol. However, Intersil has significant concerns regarding the alternative Band Limited Noise (BLN) test for which the Commission also sought comment in the NPRM.[21]

Intersil supports retaining the existing CW jamming margin test measuring DSSS equipment processing gain. The CW jammer test does the best job of showing the processing gain of the spread spectrum waveform. Adding a requirement for a theoretical explanation of the performance when the chip to symbol ratio is less than 10:1 can ensure that the gain is honestly measured. In contrast, Intersil opposes the use of a supplemental Band Limited Noise ("BLN") processing gain test as advocated by Micrilor.[22] The BLN test does not properly test for DSSS processing gain, defeating the purpose for which it has been proposed. If the Commission were to adopt a BLN test due to ease of use, Intersil favors using the system noise equivalent bandwidth test suggested by Aironet, [23] coupled with a required submission of mathematical calculations supporting compliance with the Commission's processing gain standard. However, the public interest is best served by retention of the CW jamming margin test, together with a required mathematical calculation demonstrating compliance with the DSSS processing gain requirement.

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20 NPRM at ¶ 15.

21 *Id.* at ¶ 14.

22 *See* Comments of Micrilor, Inc. (filed October 4, 1999, in this proceeding).

A. The Band Limited Noise Test Is Ineffective at Measuring DSSS Processing Gain and Should Not Be Adopted

Wideband noise is a waveform for which DSSS processing gain is ineffective. As Proxim and Micrilor admit, "[i]t is well known by practitioners of spread spectrum signaling that spread spectrum techniques were developed for combating power limited jamming; *spread spectrum signaling does not provide any improvement against white noise.*"[24] Although white noise is normally used to determine implementation loss or operating signal to noise ratio (Es/N0, or SNR), such use of white noise has nothing to do with DSSS processing gain.

1. A Brief Explanation of the CW Jamming Margin Test

The standard definition of spread spectrum processing gain is the improvement in SNR with spreading removed versus spreading enabled. This is demonstrated in the simplified block diagram shown in Figure 1 below.

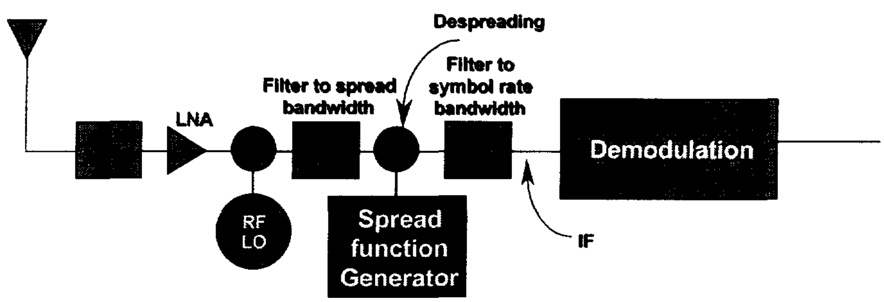

Figure 1, Reference spread spectrum receiver

In Figure 1 above, the signal is received in the spread bandwidth along with any jamming. The despreading stage can be done at IF or baseband as appropriate. The despreading stage spreads all interference, convolving the spectrum of the spreading with the spectrum of the jamming. The

[23] *See* Comments of Aironet Wireless Communications, Inc. (filed October 4, 1999, in this proceeding).
[24] Reply Comments of Proxim, Inc., and Micrilor, Inc. (filed November 19, 1999, in this proceeding).

desired signal correlates with the despreading and therefore collapses to the symbol rate bandwidth. Then the resulting signal is filtered to the symbol rate bandwidth and a large portion of the jamming energy is removed. If the spreading and despreading operations are eliminated (turned off), then the system only has the narrow band symbol rate filter for protection. Below are some examples of processing gain measurements.

First, a CW signal near the center of the band will have all of its energy in the symbol rate bandwidth and therefore, without spreading, will jam to the maximum extent as shown in Figure 2 below. With spreading, the CW spectrum is spread out to the spread bandwidth and a portion of energy equal to the ratio of the symbol rate bandwidth divided by the spread bandwidth is all that will pass through the IF filter to impact the receiver. This is, then, the classical processing gain. For example, if a 10 chip per symbol system with 10 Mcps spreading is used, the CW is spread to 10 MHz so that only ten percent (10%) of the energy passes through the IF filter. This gives a processing gain of 10:1 or 10 dB.

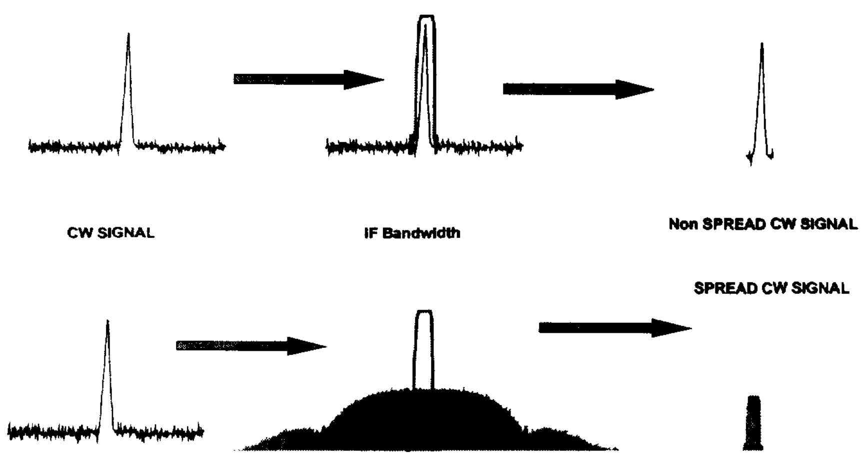

Figure 2, CW jamming shows 10 dB processing gain

Second, a wideband AWGN signal whose energy is measured in the spread bandwidth will have ninety percent (90%) of its energy removed by the IF filter in the non spread case.

When spreading is turned on, there is no essential change in the AWGN spectrum, so there is still a ninety percent (90%) loss in energy going through the IF filter. Because the improvement in SNR is nil, the processing gain is zero.

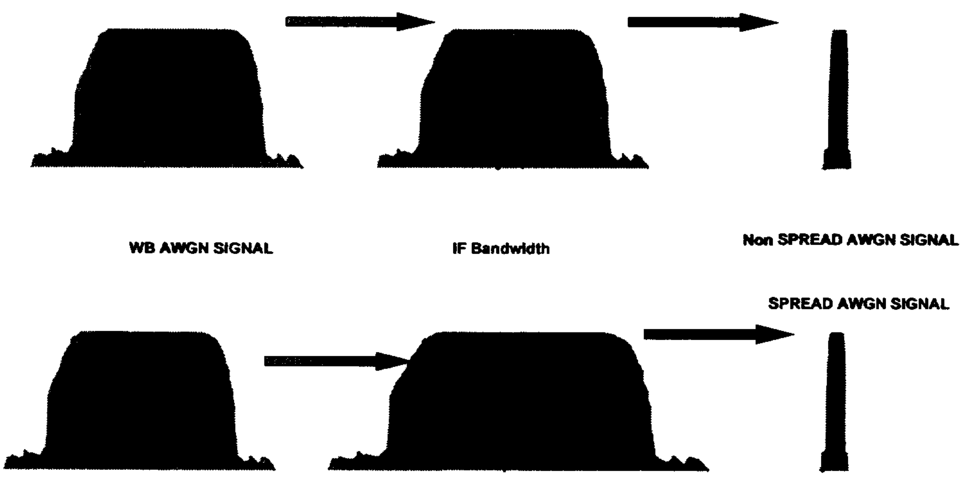

Figure 3, WB AWGN shows no processing gain

2. The BLN Test is Inaccurate for Measuring DSSS Processing Gain

Micrilor has proposed the use of a BLN test to measure DSSS processing gain. Unfortunately, the use of a BLN test as proposed by Micrilor would yield inaccurate results, and the Commission should decline to adopt such a test.

Specifically, Micrilor has suggested the use of a BLN signal of twenty five percent (25%) of the noise equivalent bandwidth of the spreading to test processing gain. As explained above, the noise equivalent bandwidth of DSSS is roughly equal to the spread rate bandwidth or half the null to null bandwidth. For our reference design, the spread rate bandwidth is 10 MHz, so the BLN jamming signal has a bandwidth of 2.5 MHz. Because this is 2.5 times the symbol rate bandwidth, the IF filtering in the non spread case yields a jamming energy of forty percent (40%) of the original. When the spreading is turned on, the jamming and spreading spectrums are convolved, yielding a total jamming spectrum bandwidth of roughly the sum of the bandwidths. Thus, the despread jamming bandwidth is 12.5 MHz. This is filtered to 1 MHz by the IF (or baseband) filter, retaining eight percent (8%) (1/12.5) of the original energy. The SNR improvement by adding spreading is then: forty percent (40%) to eight percent (8%) or 5:1. Thus, this case yields a 7 dB processing gain. As the bandwidth of the BLN signal is further widened, the processing gain tends towards zero, as demonstrated below in Figure 4.

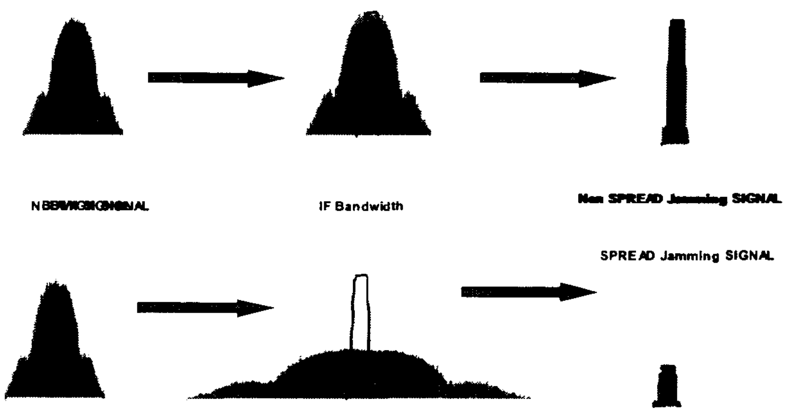

Figure 4, BLN shows 7 dB processing gain

Thus, the BLN test proposed by Micrilor is not a good test of processing gain, and the Commission should not adopt such a test.

The main argument in support of the BLN test is that it measures the jamming margin with greater ease. What can be observed in using the BLN test is that as the bandwidth of the jamming signal is increased from 0 to spreading bandwidth, the jamming margin gets better. Because CW is more harmful to DSSS systems than WB AWGN by about 1 dB due the peaking of the DSSS spectrum in the center of the band, the CW test has long been considered the best way to test spread spectrum performance. And, of course, the main reason for using the jamming margin test is that some modulation methods do not lend themselves to turning off the spreading. For these reasons, the Commission should maintain the CW jamming margin test.

For equipment that uses a spreading code of less than 10 chips per symbol, manufacturers should also submit additional mathematical calculations demonstrating compliance with the Commission's processing gain standard for DSSS systems.

B. Arguments Against the CW Jamming Margin Test Are Misplaced

Most of the jammers Intersil has encountered in this band are CW-like. Some commenters in this proceeding maintain that the large number of CW sources would combine to create a noise like spectrum. However, the central limit theorem only applies if there are large numbers of similar level signals. The usual case Intersil has seen is that one signal dominates the interference. Measurements of the GFSK signals normally encountered indicate that such signals are no more harmful than CW. Thus, CW is still a reasonable test signal for measuring processing gain.

Micrilor argues that *theoretically*, a straight PSK link could pass the CW jamming margin test with a spreading code of less than 8 chips per symbol. Micrilor is mistaken, and the reason lies in the theoretical calculations assumed by Micrilor. The IEEE 802.11 committee carefully examined many modulation methods that would meet the required data rate and at the same time have spread spectrum properties that could meet FCC requirements. CCK was selected as a waveform that has a combination of spread spectrum processing gain and coding gain combined in one symboling structure. It can easily be shown that, with this waveform, there is enough overall processing gain that is inseparable from the basic modulation spreading function. If straight PSK or QPSK is used as the modulation, with a spreading code of 1 or 2 chips per symbol, there is no chance that enough additional coding gain could be found. Even with convolutional coding or turbo coding (as some commenters have proposed), there is not enough coding gain to fill the gap. Thus, to argue that the CW jamming margin test would allow simple PSK or coded PSK schemes to pass is absurd.

C. If the Commission Adopts a Version of the BLN Test, the Commission Should Also Require the Submission of a Mathematical Calculation Demonstrating Compliance with the Processing Gain Requirement

Due to its inaccuracy, as described above, Intersil opposes the adoption of a BLN test for measuring DSSS processing gain. However, if the Commission were to adopt a version of the BLN test (perhaps due to ease of use), Intersil prefers that the Commission adopt Aironet's proposed alternative BLN test, although problems would develop with the detailed implementation of this test even as proposed by Aironet. If the Aironet suggestion of the noise equivalent bandwidth of the receiver is used, the bandwidth would be determined by the vendor and could be subject to manipulation.

If the proposed Aironet BLN test is adopted, Intersil respectfully recommends that the noise equivalent power bandwidth of the transmitter be used instead (or the ninety-five percent (95%) power bandwidth). Micrilor has suggested a figure of between fifty percent (50%) and twenty-five percent (25%) of this bandwidth, but as shown above, this results in a processing gain that differs from the true processing gain. One implementation of the test requires a narrow band filter to shape the noise. One cannot use wideband noise and just measure the power in the given bandwidth, ignoring the out-of-band noise as inconsequential. Thus, one would require three 2.4 GHz filters of about 3 MHz of bandwidth for the test. Those filters are hard to realize, having a loaded Q of 800. Alternatively, one would need to upconvert lower frequency band filtered noise to 2.4 GHz or create the noise with an I/Q modulator. One handy implementation of this would be to use one of the IEEE 802.11 transmitters, fed with a noise source at IF. This would create band filtered white noise with the same spectral shape and bandwidth as the desired signal as in the Aironet suggestion. Another alternative would be to use a non-correlating PSK transmitter as the noise source. Such a transmitter would have a matched spectrum and a peak-to-average ratio that is essentially the same as would be expected of the typical DSSS jammer. Once these details are worked through, this might form a useful alternative jamming margin test. Should such an alternative BLN test be approved, it should have the same requirement for a theoretical explanation of the processing gain when the chip to symbol ratio is less than 10:1 as Intersil supports for the CW jamming margin test. Such an additional mathematical requirement would prevent fundamentally non-spread spectrum waveforms from falsely passing a test for compliance with the FCC's processing gain standard.

Because Micrilor's proposed BLN test would prove inaccurate in measuring DSSS processing gain, and because Aironet's proposed BLN test would also complicate the issue, the Commission should maintain its current CW jamming margin test. When requesting authority for equipment with fewer than 10 chips per symbol, applicants should be required to submit mathematical calculations demonstrating compliance with the Commission's processing gain standard.

III. Conclusion

For the reasons stated herein, Intersil respectfully requests that the Commission decline to revise its Rules and policies to permit WBFH. The WBFH proposal is simply not supported by Commission precedent or by the technical record in this proceeding. It is therefore in the public interest for the Commission to reject the WBFH proposal as unsound and potentially harmful to existing and future authorized FH and DSSS equipment.

Intersil also strongly supports the Commission's retention of the CW jamming margin test, together with a mathematical calculation in support of compliance with the FCC's processing gain standard for DSSS equipment with a spreading code of less than 10 chips per symbol. Although Intersil opposes the use of an alternative BLN test, should the Commission adopt it, a mathematical calculation requirement for DSSS equipment with a spreading code of less than 10 chips per symbol should also be adopted for the BLN test. However, Intersil respectfully submits that the public interest is best served through retention of the CW jamming margin test, together with a mathematical supplement as proposed in the NPRM, as the most reliable means for measuring DSSS processing gain.

Respectfully submitted,

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